# Food price subsidies and nutrition: evidence from state reforms to India's public distribution system

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# Food Price Subsidies and Nutrition: Evidence from State Reforms to India's Public Distribution System

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## I. Introduction

Despite widespread improvements in the availability and stability of food supplies, recent estimates suggest that there are still between 700 and 870 million undernourished people in the world (Fan 2012; FAO 2012*b*; Meade and Rosen 2013). Given the difficulties faced by many households in obtaining adequate sustenance, considerable attention has been devoted to measuring different aspects of malnourishment (FAO 2012*a*), analyzing methods to better deliver food assistance (e.g., Barrett 2002), and estimating the effects of food assistance on households (e.g., Behrman and Deolalikar 1988; Barrett 2002).

This article examines the effect of a large grains subsidy in India on nutrition, where poor households purchase a ration of significantly subsidized food grains (primarily rice and wheat). We obtain information about the quantity of foods consumed in each household from large consumer expenditure surveys conducted by the government of India, and we map this to nutritional outcomes using the average nutritional content of foods common to the Indian diet. The baseline specifications focus on the effect the grains subsidy had on total protein consumption.

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A high proportion of children and adults suffer from moderate to severe grades of protein-calorie malnutrition, as observed in anthropometric indicators (e.g., Indian Council on Medical Research 2009), and thus a higher consumption of protein would unambiguously improve the health of the average Indian household. Additionally, in a number of settings, nutrient consumption is more responsive to economic shocks than energy consumption (e.g., Block et al. 2004; Brinkman et al. 2009). Thus, we focus on specifications analyzing the consumption of a number of beneficial nutrients. However, we also estimate specifications that analyze total energy consumption.

The effect of in-kind food aid on nutrition is theoretically ambiguous. Provided households are inframarginal—the amount of in-kind aid is less than what households actually consume—the effect of in-kind aid should be identical to an unconditional cash transfer. Households will increase their consumption of more nutritious food items if they are normal goods. Alternatively, consumption of these items could remain constant if households instead choose to increase their consumption of nonfood goods or food items with less nutritious content, such as processed foods (Behrman and Deolalikar 1989).

A number of studies suggest that food price subsidies have little effect on nutrition in developing countries. Using experimental evidence from China, Jensen and Miller (2011) find little evidence of any nutritional response to subsidizing staple foods. Rather, the authors find some evidence that households substitute toward foods without better nutrition or nonfood goods. Tarozzi (2005) examines a decrease in the food grains subsidy in the Indian state of Andhra Pradesh and finds little evidence of an effect on the nutrition of children younger than 4 years of age.[1]

The dietary effects of food price subsidies are particularly important in India. India contains nearly 40% of the world's food-insecure population (FAO 2012*b*). This is despite the fact that India spends nearly 1% of its GDP on maintaining its food assistance program, the Public Distribution System (PDS; Sharma 2012). This issue has become even more salient with the recent passage of the National Food Security Act (NFSA), which will dramatically expand the distribution of subsidized food grains in India. Despite this large projected increase in expenditure on food aid, previous research provides no evidence that expanding the PDS in its current form will improve calorie con-

[1] Other studies of the effects of food price subsidies in developing countries on food consumption include Gavan and Chandrasekera (1979), Alderman and von Braun (1984), Edirisinghe (1987), Kennedy and Alderman (1987), and Alderman, Chaudhry, and Garcia (1988). These studies compare participants with nonparticipants and cannot account for selection biases that prevent identification of the effects of such programs on nutrition.

sumption or diet quality in India (Tarozzi 2005; Kaushal and Muchomba 2013).

In order to estimate the nutritional effects of food price subsidies, we examine reforms to the PDS in the Indian state of Chhattisgarh that dramatically expanded the availability of PDS food grains. Previous estimates show that the distribution of subsidized food grains is highly inefficient; approximately 54% of food grains did not reach their intended beneficiaries in 2004–5 (Dreze and Khera 2011). Chhattisgarh, however, tried to improve the performance of the PDS following the formation of the state in 2000 and instituted a number of reforms to the PDS that increased the state's procurement of PDS rice as well as the number of shops devoted to selling PDS rations. Following the reforms, state procurement of PDS rice and the number of shops selling PDS commodities both increased dramatically between 1999–2000 and 2004–5.

In contrast to Chhattisgarh, aside from the national reforms, there appear to have been no major PDS reforms during the same time period in states that border Chhattisgarh (Andhra Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, and Uttar Pradesh). We exploit this difference by comparing changes in diet choice in Chhattisgarh to changes in districts that border Chhattisgarh between 1999–2000 and 2004–5. Just before its formation, average household consumption of PDS rice calories in Chhattisgarh was approximately one-third that of households in districts neighboring the state. However, following the PDS reforms, the percentage of households consuming PDS rice in Chhattisgarh nearly doubled from 10% to 19%, and the average amount consumed increased by more than 400%. In contrast, PDS consumption in neighboring districts was essentially unchanged on average during this period (Krishnamurthy, Pathania, and Tandon 2014).

In a previous article (Krishnamurthy et al. 2014) published in a widely circulated news weekly, we presented a series of stylized facts that were intended to inform the policy debate over the PDS in India. Chhattisgarh has been lauded as an example of successful PDS reform, and most observers attribute its perceived success in improving the PDS to initiatives taken by the Raman Singh government after 2004 (Puri 2012). However, we documented the fact that PDS rice consumption in Chhattisgarh rose before 2004 in response to earlier reforms and that PDS consumption growth in Chhattisgarh after 2004 is comparable to neighboring regions. In this article, we attempt to comprehensively analyze the nutritional effects of reforms undertaken in Chhattisgarh between 1999–2000 and 2004–5. Our analysis stops before the onset of the global food price spike of 2007, which likely affected PDS consumption and diet choice.

We find significant dietary changes in Chhattisgarh relative to border districts as the availability of PDS rice expanded between 1999–2000 and 2004–5. Households in the state increased their consumption of protein and a number of other beneficial nutrients relative to border districts. Growth in protein consumption was approximately 17.8% higher for households in Chhattisgarh.[2] Furthermore, we find that the growth in protein consumption is driven by households most likely to have ration cards that entitle them to the largest PDS subsidies, and we cannot reject the hypothesis that households that are least likely to possess ration cards did not change their diet relative to households in border districts. Additionally, we find evidence that households that are most likely to have ration cards also significantly increased overall calorie consumption relative to border districts, while we also cannot reject the hypothesis that households least likely to hold ration cards did not change their diet relative to households in border districts.

We rule out a number of alternative channels for our findings. Most importantly, the lack of a change in diet in households least likely to be eligible for subsidies suggests that the results are not likely to be driven by the advent of statehood and improvements in overall governance for the entire population in Chhattisgarh. Additionally, there were national reforms to the PDS that gradually increased the available rations in all states, and these reforms potentially affect the identification of the effect of the Chhattisgarh reforms. These reforms had differential effects on border districts from different states on the basis of whether the state provided more than the basic rations before the national reforms and the state's ability to distribute the additional rations. However, the additional reforms in Chhattisgarh combined with the poor pre-reform coverage of the PDS caused the increase in food grain subsidies to be much larger in Chhattisgarh than in border districts from any other state. Furthermore, the baseline patterns continue to hold when we restrict border districts to those from states where rations were larger than the provision by the central government, to those from states where grains were not efficiently distributed and the increase in rations had very little effect on actual PDS consumption, and to those where the national reforms resulted in larger PDS consumption, albeit by much less than in Chhattisgarh.

This article adds to the literature analyzing the effects of food price subsidies on diet quality and consumption. In particular, our results are related to those of Jensen and Miller (2011), who find no evidence of a nutritional re-

[2] We cannot precisely estimate which households were entitled to the largest subsidies in the preperiod, and thus we cannot precisely identify an elasticity of nutrition with respect to an increase in PDS subsidies.

sponse to food price subsidies using experimental evidence in China. This difference in findings could be a result of the nature of the subsidy. Jensen and Miller (2011) consider price subsidies for staple grains in an amount that exceeds what households would normally consume (i.e., households are not inframarginal), and thus their context involves both income and substitution effects. In contrast, the PDS rations that we consider are less than what households would normally consume, and thus this setting focuses on income effects. This difference could also stem from differences in the level of development of the treated populations. Households in Chhattisgarh that are entitled to the largest PDS subsidies are potentially less well off than the poor Chinese households analyzed by Jensen and Miller (2011).[3]

Our results also differ from studies that find no evidence for an effect of PDS consumption on malnutrition in India (Kochar 2005; Tarozzi 2005; Kaushal and Muchomba 2013). Kaushal and Muchomba (2013) estimate the relationship between nutrition levels and the size of the PDS subsidy, and instrument for the size of the PDS subsidy with the estimated probability of having a below-poverty-line (BPL) ration card. They find no effect of changes to the PDS in 2002 on nutrition in poorer and rural households.[4] However, the predictors of ration card status are correlated with a number of factors that also affect nutrition levels (e.g., wealth); thus, it is difficult to attribute these changes solely to the size of the PDS subsidies.

Tarozzi (2005) finds no evidence that a decrease in PDS subsidies affects the weight of children under 4 years of age. The differences between the results presented here and those of Tarozzi (2005) could be the result of a number of factors. First, we document a larger change in the availability of PDS food grains. Second, we are able to directly observe PDS participation and diet choice at the household level. Last, Tarozzi (2005) utilizes evidence from a state (Andhra Pradesh) in which the PDS functioned well, whereas we examine PDS expansion in a less-developed state where the PDS initially functioned poorly.

Furthermore, the results presented here are similar to those presented by Kaul (2014), which estimate the nutritional impact of the PDS by utilizing variation in the size of the subsidies given differences in states in implement-

[3] It is difficult to estimate the effect separately by wealth in the present setting. The poorest households are the only ones eligible for food price subsidies, and thus we see a larger effect for poorer households. However, we do not observe ration card status in the presurvey, and thus we cannot estimate the effect separately by wealth for only households that are eligible for subsidies.

[4] They do find evidence that households that were more likely to be eligible for PDS subsidies increased their consumption of PDS rice and wheat and lowered their consumption of coarse grains relative to households that were less likely to be eligible for subsidies.

ing the PDS, such as indexing benefits to family size, and variation in local grains prices. In contrast to analyzing variation in policies across states, we focus on a dramatic change in a single state's policies. These results also add to the literature describing the ability of the PDS to reach the poor and the implicit subsidies provided by the PDS (Dev and Suryanarayana 1991; Howes and Jha 1992; Ahluwalia 1993; Parikh 1994; Indrakanth 1997; Radhakrishna et al. 1997; Mooij 1999; Dutta and Ramaswami 2001).

Finally, this article is related to the literature analyzing the effects of in-kind food assistance on diet choice in developed countries. Utilizing natural experiments in the United States, a number of studies find that in-kind food aid leads to higher expenditure on food consumed at home (Hoynes and Shazenbach 2009; Beatty and Tuttle 2015). However, these studies are unable to identify the nutritional content of this increased spending, which is the primary focus of our analysis.[5]

The rest of the article is structured as follows. Section II describes the PDS, Section III describes the PDS reforms in the state of Chhattisgarh, Section IV describes the data, Section V describes the estimation strategy and presents the results, Section VI presents estimates of consumption changes by different types of ration cards, Section VII presents a number of robustness checks, and Section VIII concludes.

## II. The Public Distribution System

The PDS distributes a number of essential commodities to households across India. These commodities primarily consist of food grains and kerosene. Before 1997, the program was available to almost all households, at least in principle, and was intended to stabilize food prices and provide food security (Radhakrishna et al. 1997). Following 1997, the PDS was transformed into the Targeted Public Distribution System, which emphasized targeted food subsidies for the poorest households (Ministry of Consumer Affairs 2002).

The PDS is run by both central and state governments. The central government procures rice and wheat through the Food Corporation of India, which pays a government-mandated minimum support price (MSP) to farmers. The central government then allocates food grains at a much lower rate to individ-

[5] There are also a number of studies that try to estimate the marginal impact of food stamp benefits on nutrient or food availability in the United States (Ranney and Kushman 1987; Fraker 1990; Devaney and Moffitt 1991; Levedahl 1991; Fraker, Martini, and Ohls 1995). However, these studies do not rely on natural experiments and cannot account for selection issues that make such elasticities difficult to interpret.

ual states on the basis of the number of BPL households, which is determined by the official poverty line set by the Planning Commission (Ministry of Consumer Affairs 2002). Important to our analysis, the number of BPL households in Chhattisgarh relative to states bordering Chhattisgarh is relatively stable during the time period under analysis. Specifically, the size of the BPL population in each state was based on statewise poverty estimates for 1993–4 and was adjusted on the basis of population growth in 1995 and 2000. Although the relative size of the BPL population is stable, how those cards are distributed changes over time.

State governments are responsible for identifying the PDS entitlements of individual households and distributing PDS commodities through a network of fair price shops (FPSs). State governments distribute ration cards to individual households, which entitle them to different quantities and rates of PDS food grains. In this article, we refer to all ration cards that receive the most preferential rates (Antyodaya and BPL cards) as BPL ration cards, and we refer to all other ration cards as other ration cards. Households that do not have ration cards are not entitled to purchase PDS food grains.

There are large differences in the PDS consumption patterns of households with BPL ration cards and households with other types of ration cards. BPL households generally consume high levels of PDS food grains, whereas non-BPL households have much lower PDS consumption. Most non-BPL households do not consume any PDS food grains (e.g., Majumder 2001). In 2004–5, approximately 52% of BPL households in Chhattisgarh and 72% of BPL households in border districts consumed PDS rice. In contrast, very few non-BPL households consume any PDS rice. In Chhattisgarh, approximately 4% of households with other ration cards and 3% of households with no ration cards consumed some PDS rice in 2004–5. These figures are 5% and 2%, respectively, for border districts in this period.[6]

These differences are likely driven by the significantly higher prices for PDS grains faced by households without BPL ration cards. PDS grain prices for these households can sometimes rise above the local market prices (Majumder 2001). Because PDS food grains are generally viewed as inferior goods (Rao 2000; Majumder 2001), households without a BPL ration card turn to PDS grains only during times of economic distress, when market prices increase. Consistent with this explanation, PDS consumption rose across the entire country following the global food price crisis and the global financial crisis (Krishnamurthy et al. 2014).

[6] These figures are derived from the authors' calculations using the 61st round of the NSSO consumer expenditure survey.

The delivery of PDS food grains to households is inefficient in many states. Estimates of diversion—the difference in the amount of PDS rations procured by states and the amount households report they consume—are alarmingly high (Ministry of Consumer Affairs 2002; Planning Commission 2005; Jha and Ramaswami 2012). It is estimated that 54% of food grains were diverted to the open market in 2004–5 (Dreze and Khera 2011). Recent research suggests that some states have seen an improvement in PDS performance. Using a small number of districts, Khera (2011*a*) estimates that households receive more than 90% of their PDS ration on average and that they do not receive low-quality grains. Khera (2011*b*) also finds that there are only a handful of states in which the PDS continues to operate poorly, and households purchase less than 80% of their rations on average. Although it is difficult to identify exactly how states turned around their distribution of PDS food grains, Khera (2011*b*) suggests that the improvement is in part due to PDS reforms in these states.

The PDS has been widely criticized. The Ministry of Consumer Affairs published a report criticizing the PDS along a number of dimensions: types of commodities it provides, problems with targeting poor households, and inability of a large number of poor and food-insecure households to obtain BPL rates (Ministry of Consumer Affairs 2002). In light of these concerns, many commentators have called for the government to fundamentally redesign its food assistance program (Basu 2011). Other recommendations focus on improving the current system by removing above-poverty-line subsidies for grains altogether and increasing the number of households entitled to BPL rates to avoid exclusion errors in targeting subsidies (Ministry of Consumer Affairs 2002).

## III. PDS Reforms in Chhattisgarh between 2000 and 2004

Chhattisgarh instituted a number of reforms to improve the functioning of its PDS. Table 1 presents a timeline of these reforms. Most importantly for our analysis, two of these reforms took place before 2004. First, Chhattisgarh allowed private dealers to run FPSs, which improved access to FPSs across the state. Second, Chhattisgarh increased the amount of rice that it procured directly from in-state farmers to be distributed through the PDS.

Lack of access to FPSs is especially important in a predominantly rural state such as Chhattisgarh. In 2000 the number of FPSs per 1,000 people in Chhattisgarh was less than half the number in border states (fig. 1). At this time, all the FPSs in Chhattisgarh were operated by cooperatives, but according to the state government, they were not in a financial position to extend their coverage (Patnaik 2005). The government of India also voiced concerns over FPS coverage in rural areas and suggested that reforms to the operation of

**TABLE 1**

**TIMELINE OF MAJOR PUBLIC DISTRIBUTION SYSTEM (PDS) REFORMS IN CHHATTISGARH SINCE 2000**

| Year | Reform | Description |
|---|---|---|
| Instituted before Raman Singh–led government (2000–2003): | | |
| 2001 | Sarvajanik Nagrik Poorti Vitran scheme | Allowed private participation in distribution of PDS commodities |
| 2002 | Decentralized procurement scheme | Allowed state government to procure rice directly from farmers |
| Instituted by Raman Singh–led government (2004 onward): | | |
| 2004 | PDS (Control) Order of 2004 | Deprivatized FPSs, instituted a number of transparency and auditing mechanisms to distribution of food grains |

**Note.** Summary of reforms to the PDS in Chhattisgarh between 2000 and 2004–5 (replicated from Krishnamurthy, Pathania, and Tandon 2014). Top panel lists reforms instituted by the Ajit Jogi–led government, and bottom panel lists reforms instituted by the Raman Singh–led government that are relevant to the analysis. For reforms in neighboring states, we refer readers to Khera (2011*b*). FPS = fair price shop.

FPSs where coverage was limited could improve access to food aid (Government of India 2006).

In 2001, Chhattisgarh began to grant licenses to own and operate FPSs to private parties under the Sarvajanik Nagrik Poorti Vitran scheme. As a result of this reform, the number of FPSs in the state increased by 76% between 2001 and 2004 (fig. 1). By 2004, nearly 60% of FPSs were privately owned and operated.[7] Given that households are tied to a single FPS and there was such a substantial increase in the number of FPSs, there was likely a decrease in the average distance a household had to travel to purchase subsidized grains, which makes it easier to purchase the full ration.

In addition to privatizing the ownership of FPSs, Chhattisgarh also restructured its system of procurement for PDS rice. In 2002, Chhattisgarh began to participate in the decentralized procurement scheme (DCP). Under the DCP, state governments procure rice and wheat directly from local farmers at the MSP and are reimbursed by the central government. From 2002 to 2004, PDS rice procurement by Chhattisgarh rose from just under 1 million metric tons to just under 2 million metric tons, an increase of almost 100% (fig. 1). However, importantly, the scheme offered the same MSP as is offered under

[7] The privately run FPSs were not intended to compete with the nonprivate FPSs but rather for the private dealers to extend PDS subsidies to regions that did not have acceptable coverage (Patnaik 2005).

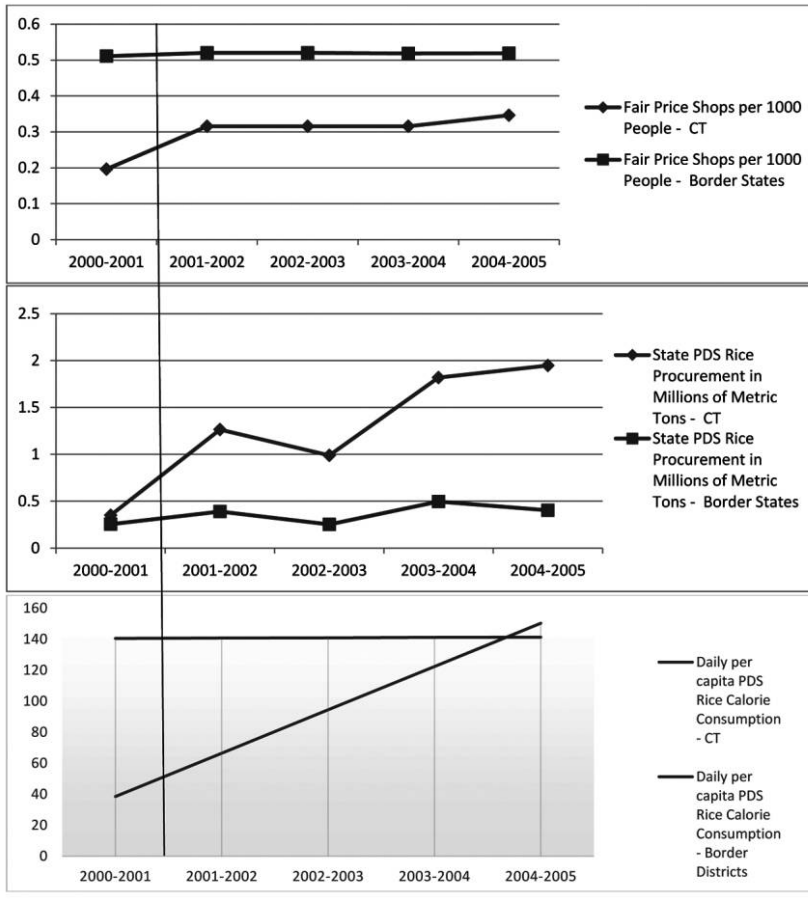


**Figure 1.** Impacts of Public Distribution System (PDS) reforms in Chhattisgarh (CT) and border regions. Top panel presents the number of fair price shops per 1,000 people in Chhattisgarh and states bordering Chhattisgarh, middle panel presents the total amount of PDS rice procured in millions of metric tons by the state government in Chhattisgarh and states bordering Chhattisgarh, and bottom panel presents daily per capita PDS rice calorie consumption in Chhattisgarh and districts bordering Chhattisgarh. Vertical line denotes the time when Chhattisgarh implemented their PDS reforms. Top and bottom panels report data that are available annually, whereas bottom panel reports the change in consumption between 2000–2001 and 2004–5. Bottom panel is qualitatively identical if all households from bordering states are included. Top and middle panels are replicated from Krishnamurthy et al. (2014). Data are obtained from annual reports published by the Ministry of Consumer Affairs and from "Programme Evaluation of Targeted Public Distribution System," published by the Planning Commission in 2005. Data on fair price shops and state PDS rice procurement are not available at the district level from these sources. Bottom panel uses data from the 55th and 61st rounds of the consumer expenditure surveys conducted by the National Sample Survey Organization. States that border Chhattisgarh are Andhra Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, and Uttar Pradesh. A color version of this figure is available online.

centralized procurement, and the program likely did not have any significant income effects for Chhattisgarh farmers. Rather than trying to provide additional income support for farmers, the primary benefits of the procurement scheme, according to the Ministry of Consumer Affairs, is to provide grains

that are better suited to local tastes.[8] It is possible that the increased availability of grains that suited local tastes slightly increased the amount of PDS grains that households were willing to consume and could represent an increase in the availability of PDS food grains relative to border districts.

In contrast, states with districts that share a border with Chhattisgarh did not, to the best of our knowledge, undertake comparably comprehensive state-specific PDS reforms between 1999 and 2004. A search of news stories in the *Times of India* and the *Hindu* from 1998 to 2005 reveals no evidence of large-scale PDS reforms in neighboring states, and studies of PDS diversion across states over this time period do not mention reforms in these states (Khera 2011*a*, 2011*b*).[9] However, a number of states bordering Chhattisgarh Andhra Pradesh, Madhya Pradesh, and Odisha implemented PDS reforms after 2005, and thus we restrict the analysis between 1999–2000 and 2004–5.

Consistent with the Chhattisgarh PDS reforms having an effect, per capita consumption of PDS rice more than tripled over the period under analysis (fig. 1).[10] However, consistent with the lack of reform in bordering states, there was little change in FPS coverage, PDS rice procured directly by governments, and average PDS rice consumption in states that border Chhattisgarh (fig. 1).[11]

However, there were national changes to the PDS over this time period that affected all states. Specifically, there was a gradual increase of the BPL ration over the time period as well as a slight decrease in the price of PDS grains for BPL cardholders. The ration was increased from 20 to 25 kilograms in July 2001 and then further to 35 kilograms in April 2002, and the price of BPL grains was decreased from 50% of cost to the Food Corporation of India to 48% (Umali-Deininger, Sur, and Deininger 2005).

[8] For example, see the description of the program from the Ministry of Consumer Affairs (http://dfpd.nic.in/decentralized-procurement.htm).

[9] Specifically, we searched the two newspapers using Factiva. We searched for the words "public," "distribution," and "system" and the name of the state in each individual search.

[10] This figure is reproduced from Krishnamurthy et al. (2014).

[11] It is important to note that there were differences in the trends in PDS rice consumption in Chhattisgarh and border districts in the period before the PDS reforms. The Targeted Public Distribution System (TPDS) was only introduced in 1997. Before the TDPS, the subsidies were very small, and PDS grains were available to all households. As a result of the small subsidy, there was very little PDS consumption before the introduction of the large subsidy for BPL households in 1997. Once the larger subsidy for poor households was introduced, there were large changes in PDS consumption in some states that were able to distribute a significant amount of rations to poor residents (e.g., Andhra Pradesh, Orissa). However, the districts that later formed Chhattisgarh had few FPSs, and a significant amount of grains were diverted to the open market. As a result, there was not as large of an increase in PDS consumption in Chhattisgarh when the TDPS was introduced relative to the average change in all of the districts that border Chhattisgarh.

Although these are sizable increases in food price subsidies, the national reforms likely did not have as large of an effect as expected in a number of states that border Chhattisgarh. First, during the time period, a large share of grains did not make it to beneficiaries in a number of states and were rather diverted to the market (Khera 2011*b*). Thus, in the states where PDS grains were very inefficient (e.g., Jharkhand, Uttar Pradesh), there was little change in PDS consumption following the national reforms. Second, other states were already providing rations above the quota before the national reforms (e.g., Andhra Pradesh, Orissa), and thus there was similarly little change in PDS consumption in those states (e.g., Dutta and Ramaswami 2001; Bedamatta 2006).

Alternatively, the increase in household PDS consumption in Chhattisgarh (317%) far outpaced the increase in border districts contained in states where the national quota increase did increase PDS consumption: Madhya Pradesh (175%) and Maharashtra (111%). This difference is likely driven by two factors. First, the expansion of FPSs in Chhattisgarh that did not occur in neighboring states allowed beneficiaries to collect the original rations that they were unable to purchase. Second, the expansion of FPSs also allowed the state to distribute a higher share of the grains included in the quota increase, given still pervasive leakages in the PDS in both Madhya Pradesh and Maharashtra (e.g., Khera 2011*b*).

Given potential variation in the degree of treatment in these three different groups, in addition to analyzing the changes in nutrition in Chhattisgarh to all border districts, we also analyze the change in Chhattisgarh relative to border districts in states where rations were larger than the provision by the central government (Andhra Pradesh and Orissa), in states where grains were not efficiently distributed and the increase in rations had very little effect on actual PDS consumption (Jharkhand and Uttar Pradesh), and in states where the national reforms resulted in larger PDS consumption, albeit by much less than in Chhattisgarh (Madhya Pradesh and Maharashtra). Last, there was an announced PDS reform in Chhattisgarh that affected the expansion of FPS coverage. Specifically, the PDS (Control) Order of 2004 was announced at the end of December 2004, which, among other things, discontinued the operation of private FPSs. However, implementation of the order was delayed until the resolution of a Supreme Court case in September 2005 after the end of the postsurvey used in the analysis (Patnaik 2005). It is likely that during this period of uncertainty, privately run FPSs discontinued operation before the FPSs could be turned over to the Gram Panchayats, cooperative societies, self-help groups, and forest protection committees that were permitted to operate them. Thus, if the uncertainty led to a decline in FPSs in 2005 relative to 2004, we

could expect a larger change in nutrition for households surveyed in 2004 as opposed to those surveyed in 2005.

Consistent with the uncertainty leading to the exit of FPSs, there was a sharp drop in PDS rice consumption in Chhattisgarh between households surveyed in 2004 and those surveyed in 2005, while there was no change in districts bordering Chhattisgarh (Krishnamurthy et al. 2014). Despite this decline, PDS rice consumption in Chhattisgarh was still much higher in 2005 than in 1999–2000. Furthermore, this difference between Chhattisgarh and border districts cannot be explained by observable characteristics in the households surveyed in 2004 and 2005. The 2004–5 consumer expenditure survey was conducted from June 2004 to June 2005, and the stratification of households surveyed between June–December 2004 and January–June 2005 was identical in order to avoid issues with seasonality.

## IV. Data

In order to estimate the response of diet choice to PDS consumption, we utilize consumption data obtained from consumer expenditure surveys conducted by the National Sample Survey Organization (NSSO) in India. Each survey is a repeated cross section and covers the entire country. The survey is stratified by geographical area and whether a household resides in a rural or urban area. After the primary sampling units have been randomly selected, the survey is further stratified by household affluence. In the baseline estimates, we utilize the thick rounds conducted in 1999–2000 (55th round) and 2004–5 (61st round).

Each survey provides data on quantities and values of approximately 150 food items consumed over the past 30 days and separately reports the amount of PDS rice, wheat, sugar, and kerosene consumed by each household. We utilize the 30-day reference period, as opposed to the 7-day reference period, for the 55th round to make it more comparable to the 61st round.[12] Each survey also reports a number of household characteristics and the district in which each household resides. From these data, we are able to estimate consumption of macro- and micronutrients from each source by utilizing nutritional information provided by Gopalan, Rama Sastri, and Balasubramanian (1989), which is the source commonly used by the Government of India to estimate the nutritional content of consumption from NSSO data (e.g., National Sample Survey Organization 2007). Gopalan et al. (1989) provides nutritional information for 592 food items that are common in the Indian diet,

[12] However, the rounds are not entirely comparable, given that the same households were asked to report both 7- and 30-day recall periods in the 55th round (e.g., Deaton and Dreze 2002; Deaton and Kozel 2005).

which is a much finer level of detail than reported by the NSSO consumer expenditure survey.[13] We estimate nutritional information only for foods consumed at home. This omits certain processed foods and meals consumed outside the household, for which nutritional information is difficult to precisely estimate.

There are some differences between the two surveys used in the baseline analysis. Although both surveys provide information on the amount of PDS commodities consumed, only the survey conducted in 2004–5 contains information on whether households have a ration card entitling them to purchase PDS food grains. The survey conducted in 1999–2000 did ask whether the lack of a ration card was the reason no PDS purchase was made in the prior 30 days. Unfortunately, the NSSO did not include this information on the publicly available data file. This difference between the surveys matters most in specifications in which changes in diet choice are estimated separately for households with different types of ration cards.

We use these surveys to compare nutrient consumption in Chhattisgarh—or districts in Madhya Pradesh that would later become Chhattisgarh—to nutrient consumption in districts that border the state. District boundaries change over time, so we utilize the boundaries in effect in 1999, the time the baseline survey (55th round) used in the empirical analysis was conducted. However, during the time period, one district was carved out of two existing districts. In this instance, the two districts were aggregated to a larger region to keep borders consistent across all surveys. The border districts come from a number of states: Andhra Pradesh (three), Jharkhand (three), Maharashtra (two), Madhya Pradesh (six), Odisha (eight), and Uttar Pradesh (one).[14] Figure 2 presents a map of Chhattisgarh and districts that border the state.

[13] For example, household calorie consumption is calculated as $\Sigma_{g=1}^{N}\text{Quantity}_g \times \text{AveCalorie}_g$ for each household, where $g$ denotes each food item, $\text{Quantity}_g$ denotes the total household consumption of good $g$, and $\text{AveCalorie}_g$ denotes average calories contained per unit of good $g$ and is obtained from Gopalan et al. (1989). For the calculation of other nutrients, we use the average nutritional value per unit of food item $g$ obtained from Gopalan et al. (1989; e.g., $\text{AveProtein}_g$). There exist other sources to estimate calorie information, such as the concordance used by the Food and Agriculture Organization of the United Nations (FAO; http://faostat.fao.org). However, the list of food items detailed by FAO is not nearly as detailed as that detailed by Gopalan et al. (1989; contains approximately one-tenth of the food items), and the food items are not tailored specifically to foods commonly consumed in India. Regardless, the nutritional content of consumption is similar when using both of these two mappings (e.g., Tandon and Landes 2011).

[14] The districts that border Chhattisgarh are listed as follows: from Andhra Pradesh: Karimnagar, Khammam, Warangal; from Jharkhand: Garhwa, Gumla, Simdega; from Maharashtra: Bhandara, Chandrapur; from Madhya Pradesh: Anuppur, Balaghat, Dindori, Shahdol, Sidhi, Singrauli; from Odisha: Bargarh, Jharsuguda, Kalahandi, Koraput, Malkangiri, Nabarangpur, Naupada, Sundargarh; and from Uttar Pradesh: Sonbhadra.

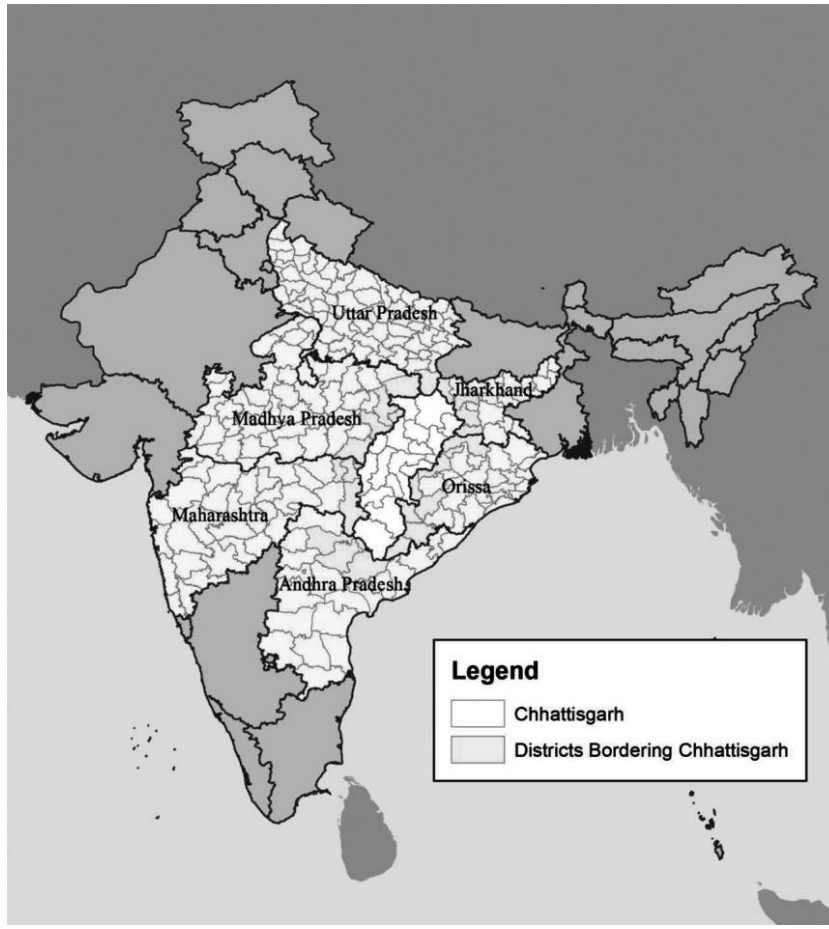


**Figure 2.** Map of Chhattisgarh and border districts. Since the state formed in 2000, a small number of districts that had bordered Chhattisgarh split into two districts, one of which no longer borders the state in the 2004–5 survey. However, to be consistent, 1999–2000 boundaries are used, and all regions that had bordered Chhattisgarh at that time are identified as border districts. The districts that border Chhattisgarh are as follows: from Andhra Pradesh: Karimnagar, Khammam, Warangal; from Jharkhand: Garhwa, Gumla, Simdega; from Maharashtra: Bhandara, Chandrapur; from Madhya Pradesh: Anuppur, Balaghat, Dindori, Shahdol, Sidhi, Singrauli; from Orissa: Bargarh, Jharsuguda, Kalahandi, Koraput, Malkangiri, Nabarangpur, Naupada, Sundargarh; and from Uttar Pradesh: Sonbhadra. A color version of this figure is available online.

Table 2 presents summary statistics separated by survey and illustrates a number of important consumption patterns. First, in the 2004–5 survey, slightly less than one-third of households have a BPL card entitling them to the largest PDS subsidies, and approximately 38% of households have no ration cards and therefore are not entitled to purchase PDS food grains. Therefore, each type of household is well represented in the sample, which allows us to separate consumption by type of ration card in the 2004–5 survey. Second, average calorie consumption and protein consumption for the entire sample

TABLE 2
SUMMARY STATISTICS FOR CHHATTISGARH AND BORDER DISTRICTS BY SURVEY

| | 1999–2000 (1) | 2004–5 (2) |
|---|---|---|
| Daily per capita consumption: | | |
| Protein (grams) | 52.6 (31.1) | 51.2 (25.5) |
| Calories | 2,060.0 (937.2) | 1,923.0 (757.9) |
| Dietary minerals (manganese, copper, iodine, zinc, cobalt, fluoride, and selenium [grams]) | 7.72 (6.31) | 7.78 (5.20) |
| Calcium (grams) | 285.3 (871.9) | 355.7 (744.3) |
| Iron (grams) | 23.0 (13.0) | 27.5 (43.0) |
| Fiber (grams) | 4.83 (6.55) | 4.93 (9.31) |
| Share of households: | | |
| With a BPL card | . . . | .313 (.464) |
| With a non-BPL card | . . . | .305 (.460) |
| With no ration card | . . . | .382 (.486) |
| That are self-employed | .152 (.359) | .246 (.431) |
| That are rural | .708 (.454) | .727 (.446) |
| That belong to a scheduled caste | .148 (.355) | .150 (.357) |
| That belong to a scheduled tribe | .271 (.444) | .270 (.444) |
| That belong to an other backward class | .385 (.487) | .417 (.493) |
| That are Hindu, Sikh, Jain, or Buddhist | .944 (.229) | .937 (.244) |
| That are Muslim | .029 (.169) | .029 (.169) |
| That are Christian | .026 (.160) | .034 (.181) |
| With household members that are illiterate | .473 (.349) | .420 (.331) |
| With heads that are illiterate | .424 (.494) | .371 (.483) |
| With spouses that are illiterate | .553 (.497) | .501 (.500) |
| With heads that never attended school | .443 (.497) | .384 (.486) |
| With spouses that never attended school | .722 (.448) | .684 (.465) |
| That have a spouse | .839 (.368) | .822 (.383) |
| Observations | 5,787 | 7,029 |

**Note.** Summary statistics of household diet choice and household-level controls used in the empirical analysis. Variable means are presented for each time period, and standard deviations are presented in parentheses. Data from 1999–2000 are from the 55th round of the consumer expenditure survey, and data from 2004–5 are from the 61st round of the consumer expenditure survey. BPL = below poverty line.

declined between the 55th and 61st rounds, which is consistent with national trends over this time period (e.g., National Sample Survey Organization 2007; Deaton and Dreze 2009). In addition to the thick rounds conducted in 1999–2000 (55th round) and 2004–5 (61st round), this study also utilizes the thick round conducted in 1993–4 (50th round) and utilizes the thin rounds conducted in 1997 (53rd round) and 1998 (54th round) to estimate trends in consumption before the formation of Chhattisgarh.[15]

[15] The sampling procedure is different between the thin and thick rounds. For both thin and thick rounds the stratification is based on sector (rural vs. urban) and relative affluence, but the relative size of the rural/urban sample in the two types of rounds differ. However, all results comparing the two types of surveys are identical when conditioning on sector and affluence and are similar if we restrict the analysis to particular second-stage strata within which there is random sampling of households. Furthermore, the thin rounds also report fewer household characteristics than the thick rounds, which limits household-level control variables in specifications using both types of rounds to those that are available in all surveys.

## V. Estimation Strategy and Baseline Results

Our identification strategy is to compare changes in nutrient consumption of households in Chhattisgarh to those of households in districts bordering the state that did not experience reforms. We utilize households in border districts to construct the counterfactual of consumption changes in Chhattisgarh in the absence of PDS reforms. Households in border districts are more likely to be similar to households in Chhattisgarh in terms of their unobserved characteristics than are households from the rest of India. Table 3 presents summary statistics for nutrient consumption and household characteristics for households in Chhattisgarh and those in border districts before the PDS reforms. Consistent with our assumption, column 3 shows that there are few observable differences between households in Chhattisgarh and border districts aside from PDS consumption.

We implement this identification strategy by estimating the following baseline specification:

$$\ln(\text{Nutrient\_Consumption}_{idt}) = \kappa_d + \gamma CT_{idt} \times Post_{idt} + \beta X_{idt} + \epsilon_{idt}, \quad (1)$$

where $d$ denotes districts according to 1999 boundaries, $t$ denotes the time period ($t = 1999, 2004$), $\kappa_d$ denotes district fixed effects, Nutrient_Consumption denotes daily per capita consumption of protein and other nutrients, $CT$ denotes an indicator equal to 1 if the household resides in Chhattisgarh, $Post$ denotes an indicator equal to 1 if the household observation is taken from the 2004–5 survey, and $X$ contains $Post$ and time-varying control variables.[16]

The coefficient of interest is $\gamma$, which gives the difference-in-differences estimate of the effect of PDS reforms on nutrient consumption. If the increased availability of PDS rice led to higher nutrient consumption in Chhattisgarh relative to border districts, then estimates of $\gamma$ should be positive and significant. The baseline specification estimates robust standard errors clustered at the district level. To account for the possibility of state-level correlation in the error term, we also include $p$-values based on standard errors clustered at the state level. Given the small number of border states, we estimate the standard errors clustered at the state level in two ways: using the wild cluster

[16] Controls include indicators for whether a household resides in a rural area, indicators for whether a household is self-employed, indicators for household religion (Muslim, Christian, Hindu/Sikh/Jain/Buddhist), and indicators for whether a household belongs to a scheduled caste or a scheduled tribe, an indicator for whether the household belongs to an otherwise backward class, the share of the household that is illiterate, an indicator equaling 1 if the household head is illiterate, an indicator equaling 1 if the spouse of the household head is illiterate, an indicator equaling 1 if the household head did not ever attend school, an indicator equaling 1 if the spouse of the household head did not ever attend school, and an indicator equaling 1 if the household head is married.

## TABLE 3

AVERAGE NONGRAIN CONSUMPTION AND HOUSEHOLD CHARACTERISTICS IN CHHATTISGARH AND BORDER DISTRICTS BEFORE PUBLIC DISTRIBUTION SYSTEM (PDS) REFORMS

| | Average in Chhattisgarh in 1999–2000 (1) | Average in Border Districts in 1999–2000 (2) | Difference (col. 1 − col. 2) (3) |
|---|---|---|---|
| ln(per capita calorie consumption from PDS rice) | .908 | 3.13 | −2.22*** |
| | (.570) | (.074) | (.422) |
| ln(per capita consumption of protein) | 7.23 | 7.26 | −.024 |
| | (.017) | (.012) | (.049) |
| ln(per capita consumption of total calories) | 10.9 | 10.9 | −.032 |
| | (.020) | (.014) | (.049) |
| ln(per capita consumption of minerals) | 5.31 | 5.34 | −.027 |
| | (.014) | (.010) | (.064) |
| ln(per capita consumption of iron) | 6.40 | 6.40 | −.002 |
| | (.016) | (.011) | (.074) |
| ln(per capita consumption of calcium) | 8.76 | 8.77 | −.014 |
| | (.022) | (.015) | (.118) |
| ln(per capita consumption of fiber) | 4.61 | 4.76 | −.150 |
| | (.017) | (.013) | (.133) |
| Self-employed | .147 | .155 | −.008 |
| | (.007) | (.006) | (.014) |
| Rural | .707 | .710 | −.003 |
| | (.010) | (.008) | (.055) |
| Scheduled caste | .139 | .154 | −.015 |
| | (.007) | (.006) | (.029) |
| Scheduled tribe | .263 | .276 | −.013 |
| | (.009) | (.008) | (.071) |
| Other backward class | .427 | .358 | .069 |
| | (.010) | (.008) | (.073) |
| Hindu, Buddhist, Sikh, or Jain | .955 | .938 | .017 |
| | (.004) | (.004) | (.015) |
| Muslim | .028 | .030 | −.002 |
| | (.003) | (.003) | (.010) |
| Christian | .017 | .032 | −.015 |
| | (.003) | (.003) | (.015) |
| Illiterate household members | .450 | .489 | −.039 |
| | (.007) | (.006) | (.032) |
| Illiterate household head | .394 | .443 | −.049 |
| | (.010) | (.008) | (.041) |
| Illiterate spouse | .550 | .555 | −.006 |
| | (.010) | (.008) | (.027) |
| Heads that never attended school | .411 | .464 | −.054 |
| | (.010) | (.008) | (.042) |
| Spouses that never attended school | .723 | .721 | .002 |
| | (.009) | (.008) | (.031) |
| Households that have a spouse | .836 | .841 | −.005 |
| | (.008) | (.006) | (.015) |
| Observations | 2,292 | 3,495 | . . . |

**Note.** Summary statistics of consumption and household characteristics in the 1999–2000 National Sample Survey Organization consumer expenditure survey (before the formation of Chhattisgarh) that are used as control variables in the empirical analysis. Standard errors clustered by district are presented in parentheses.

*** Statistical significance at the 1% level.

bootstrap percentile-t method described by Cameron, Gelbach, and Miller (2008) and using randomization inference, which is described by Cohen and Dupas (2010).

Households in Chhattisgarh increased their protein consumption relative to border districts between 1999–2000 and 2004–5. Table 4 reports these findings from the baseline specification. Column 1 estimates the simplest difference-in-differences specification, column 2 adds district fixed effects, column 3 adds household-level control variables, and column 4 adds NSSO sampling weights to make the estimate representative of the population. The estimates are positive and similar in magnitude, and the estimates are most precisely estimated in the most complete specifications. In the most complete specifications in columns 3 and 4, households in Chhattisgarh increased their consumption of protein by 17.8% and 25.5% more than households in border districts. Although the estimates are slightly less precisely estimated, the results are similar when clustering the standard errors at the state level. However, it is important to note that given the small number of states, the lowest attainable $p$-value using randomization inference is 0.143.

Chhattisgarh had higher growth in the consumption of a number of other beneficial nutrients. Columns 5–9 of table 4 reports estimates of specifications using consumption of other nutrients as the dependent variable. In particular, total consumption of iron, calcium, and dietary minerals (manganese, copper, iodine, zinc, cobalt, fluoride, and selenium) significantly increased in Chhattisgarh relative to border districts. However, the estimate of total calorie consumption was less precisely estimated. Thus, although calorie consumption increased in Chhattisgarh relative to border districts, one cannot reject the hypothesis that the change was identical in the two regions at standard levels of significance in specifications that use the entire sample of households from Chhattisgarh.[17]

Important to the interpretation of the results presented in tables 4 and S1 (tables S1, S2 are available online) demonstrates that there were not any differential income effects for farmers primarily engaged in cereal cultivation in

[17] The increase in calorie consumption in Chhattisgarh was less robust than the increase in other nutrients (protein, dietary minerals, and calcium) because households reduced consumption of oils. Oils typically used in Indian diets are rich in calories and fat but contain no other beneficial nutrients (Gopalan et al. 1989). Consistent with poorer households using more oils in food preparation than richer households to maintain adequate calorie consumption, in specifications not reported, we find that oil consumption increases with expenditure across all of India but at a rapidly declining rate. The rate is declining quickly enough such that the correlation is positive for households below the median nonfood expenditure, and the correlation is negative for households above the median nonfood expenditure.

## TABLE 4

DIFFERENCES IN GROWTH OF NONGRAIN CONSUMPTION BETWEEN CHHATTISGARH AND BORDER DISTRICTS

| | Dependent Variable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ln(Protein) | | | | ln(Calories) | ln(Minerals) | ln(Iron) | ln(Calcium) | ln(Fiber) |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| *CT* × *Post* | .155** | .181** | .178** | .255* | .203 | .200* | .270** | .444** | .121 |
| | (.074) | (.066) | (.065) | (.125) | (.183) | (.112) | (.121) | (.173) | (.182) |
| District fixed effects | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Control variables | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Sampling weights | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| *p*-value BS | .140 | .086* | .094* | .094* | .388 | .376 | .126 | .178 | .534 |
| *p*-value RI | .143 | .143 | .143 | .143 | .286 | .143 | .143 | .143 | .571 |
| Observations | 12,816 | 12,816 | 12,816 | 12,816 | 12,816 | 12,816 | 12,816 | 12,816 | 12,816 |

**Note.** Difference-in-differences estimates for consumption between 1999–2000 and 2004–5. Columns 1–4 estimate the baseline specification using the natural logarithm of total household consumption of protein over the past 30 days as the dependent variable, and columns 5–9 estimate the baseline specification for additional measures of total household nutrition. Control variables included are listed in footnote 17. For specifications without district fixed effects, control variables also include an indicator equaling 1 if the household resided in Chhattisgarh. Standard errors clustered by district are reported in parentheses. All specifications also report *p*-values of the coefficient on the interaction of the Chhattisgarh indicator (*CT*) and a *Post* variable using the wild cluster bootstrap percentile-t method (*p*-value BS) and randomization inference (*p*-value RI) to estimate standard errors clustered by state.

* Significance at the 10% level.

** Significance at the 5% level.

Chhattisgarh relative to border states, where decentralized procurement was not similarly adopted. Furthermore, the baseline empirical patterns we find are identical when we restrict the sample to urban households or to households that do not rely on either cereal production or any other type of agricultural production.[18]

## VI. Consumption Changes by Type of Subsidy

We separately estimate the growth of protein consumption in Chhattisgarh, relative to border districts, on the basis of eligibility for PDS subsidies. However, we do not observe ration card status in the preround and thus cannot observe the amount of food price subsidies to which each household is entitled. Thus, we rely on estimating the baseline specification separately for households on the basis of their predicted probability of having a ration card. The predicted probability is derived using predictors of ration card status in the postround, where we do observe ration card status of each household.

Specifically, we estimate the probability of a household having a BPL ration card using a probit specification in the 2004–5 survey, where the set of control variables in the baseline specification are used as predictors of ration card status.[19] We then use these fitted values to estimate the probability of ration card status in both the 1999–2000 and 2004–5 surveys.

Utilizing these estimates, we reestimate the baseline specification separately for each quintile of predicted probabilities. The estimates are presented in columns 1–5 of table 5. Columns 1 and 2 demonstrate that we cannot reject the hypothesis that the changes in protein consumption in Chhattisgarh and border districts were identical for the two quintiles that were least likely to be entitled to the largest PDS subsidies. However, the estimates in columns 3–5 demonstrate that changes in protein consumption in the baseline specification were driven by the three quintiles most likely to be entitled to the largest subsidies. The point estimates are higher than those presented in columns 1 and 2, and the estimates are more precisely estimated.[20]

In addition to proxying for ration card ownership in the preperiod, we also compare protein consumption by type of ration card in the postsurvey to average consumption in the presurvey. We estimate the baseline specification while restricting postobservations to households with BPL ration cards and

[18] These results are available upon request from the authors.

[19] See table S2 for the estimates from this specification.

[20] Alternatively, it is possible to estimate a model pooling all households and interacting quintile indicators with a Chhattisgarh indicator and a Post indicator. Estimates from such a specification yield similar results to estimates presented in table 5, where households that are most likely to have BPL cards are those for whom nutrition increased following the PDS reforms.

**TABLE 5**
**BASELINE ESTIMATES SEPARATED BY TYPE OF RATION CARD**

| | Restrict Sample to Quintile of Probability of Having a Ration Card | | | | | Restrict Sample to Households in Postsurvey | |
|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th | With BPL Cards | Without BPL Cards |
| Dependent variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| ln(protein) | .178 | .105 | .263** | .115 | .175* | .198** | .086 |
| | (.129) | (.093) | (.114) | (.088) | (.091) | (.068) | (.065) |
| *p*-value BS | .224 | .252 | .016** | .17 | .304 | . . . | . . . |
| *p*-value RI | .286 | .286 | .143 | .143 | .286 | . . . | . . . |
| ln(calories) | .124 | .034 | .153 | .091 | .174** | .136* | −.024 |
| | (.103) | (.111) | (.162) | (.086) | (.084) | (.069) | (.067) |
| *p*-value BS | .434 | .621 | .044** | .232 | .460 | . . . | . . . |
| *p*-value RI | .429 | .429 | .143 | .286 | .286 | . . . | . . . |
| Observations | 1,398 | 2,498 | 2,993 | 3,161 | 2,766 | 4,308 | 6,176 |

**Note.** Difference-in-differences estimate for consumption between 1999–2000 and 2004–5 separated by types of subsidies to which households are entitled. Top panel utilizes the natural logarithm of total protein consumed as the dependent variable, and bottom panel utilizes the natural logarithm of total calories consumed. Each cell represents an estimate of the coefficient of an interaction between the Chhattisgarh and *Post* indicators in the baseline specification, restricted to a different subset of the total sample. Columns 1–5 restrict the sample to quintiles of the estimated probability of having a ration card on the basis of demographic control variables used in the baseline specification; columns 6–8 restrict the sample to households with a below-poverty-line (BPL) ration card, above-poverty-line ration card, and no ration card, respectively, in the postperiod. Columns 6–8 exclude households residing in the states that are the most dissimilar to Chhattisgarh in terms of protein consumption and expenditure (Andhra Pradesh, Maharashtra, Orissa, and Uttar Pradesh). All specifications include district fixed effects and control variables. Control variables included are listed in footnote 17. All specifications also report *p*-values of the coefficient on the interaction of the Chhattisgarh indicator and a *Post* variable using the wild cluster bootstrap percentile-t method (*p*-value BS) and randomization inference (*p*-value RI) to estimate standard errors clustered by state. Standard errors clustered by district are reported in parentheses.

* Significance at the 10% level.

** Significance at the 5% level.

all households without a BPL card. For these specifications, $\gamma$ measures the difference between the average protein consumption for ration card holders in the postsurvey and the average for all households in the presurvey in Chhattisgarh relative to border districts.

However, restricting the sample in the postperiod by type of ration card requires additional assumptions to produce unbiased difference-in-differences estimates. To see what those conditions might be, we first derive the estimate of our ideal specification where we can identify BPL card holders in both the pre- and postperiods. Specifically, we would have computed the following double difference estimator for the BPL sample:

$$\begin{aligned} DD &= E\left[Y^T_{post,B} - Y^T_{pre,B} \mid X\right] - E\left[Y^C_{post,B} - Y^C_{pre,B} \mid X\right], \\ &= E\left[Y^T_{post,B} - Y^C_{post,B} \mid X\right] - E\left[Y^T_{pre,B} - Y^C_{pre,B} \mid X\right]. \end{aligned}$$

Here, $Y^{s}_{t,i}$ is the outcome of interest (i.e., nongrain calorie consumption) for the treatment ($T$) or control ($C$) states in the period $t$ (pre- or postperiod) for group $i$ (BPL card holders [$B$] or others [$N$]). The second row is an equivalent way of expressing the double-difference estimator; it nets out the preperiod difference in levels between the treatment and control groups from the postperiod difference and attributes any residual change to the treatment.

However, since we can identify only the BPL card holders in the postperiod, we estimate specifications in which we restrict the postperiod sample to BPL card holders only (while keeping the entire preperiod sample, which is a mix of BPL card holders and the others). Let $\alpha^{T}$ and $\alpha^{C}$ be the fraction of sampled households that do not own BPL cards in the treatment and control states, respectively. Assume that these fractions remain the same in the pre- and postperiods. Then our modified specification estimates the following double difference:

$$\begin{aligned} DD' &= E\left[Y^{T}_{post,B} - \left(\alpha^{T} Y^{T}_{pre,N} + (1-\alpha^{T}) Y^{T}_{pre,B}\right) \mid X\right] \\ &\quad - E\left[Y^{C}_{post,B} - \left(\alpha^{C} Y^{C}_{pre,N} + (1-\alpha^{C}) Y^{C}_{pre,B}\right) \mid X\right], \\ &= E\left[Y^{T}_{post,B} - Y^{C}_{post,B} \mid X\right] \\ &\quad - E\left[\left(Y^{T}_{pre,B} + \alpha^{T}(Y^{T}_{pre,N} - Y^{T}_{pre,B})\right) - \left(Y^{C}_{pre,B} + \alpha^{C}(Y^{C}_{pre,N} - Y^{C}_{pre,B})\right) \mid X\right]. \end{aligned}$$

The second decomposition of the modified estimator ($DD'$) as shown in the equation above is instructive. Once again, the preperiod difference in levels between the treatment and control group is being netted out of the postperiod difference except for the fact that the preperiod difference is for the entire sample, which is a mix of BPL card holders and the others.

We can see the source of potential bias in $DD'$ when we compare the above expressions. While we estimate the same (conditional) postperiod difference between the treatment and control group in both cases, we have different estimates of the preperiod difference. We can formalize the bias as follows:

$$\begin{aligned} \text{Bias} &= DD' - DD \\ &= E[\alpha^{C}(Y^{C}_{pre,N} - Y^{C}_{pre,B}) - \alpha^{T}(Y^{T}_{pre,N} - Y^{T}_{pre,B}) \mid X]. \end{aligned}$$

There are a number of things to note about this expression. First, note that $\alpha^{T}, \alpha^{C} > 0$. Similarly, we expect that $E[Y^{C}_{pre,N} - Y^{C}_{pre,B}|X]$ and $E[Y^{T}_{pre,N} - Y^{T}_{pre,B}|X]$ to be positive since BPL card holders are among the poorest in the population. Therefore, both terms in the equation are positive. The first term measures the positive distortion to the conditional mean $Y$ of the BPL card holders in the control states because of the fact that we are actually measuring the conditional mean of the entire sample (BPL and others.) This distortion

is increasing in the share of the non-BPL card holders in the sample ($\alpha^C$) and the intergroup difference in means ($Y^C_{pre,N} - Y^C_{pre,B}$). The second term measures this distortion for the treatment state.

It is important to note that all the bias stems from mismeasurement in the starting points for the double difference estimation. Intuitively, if the starting point for the control states is more distorted than for the treatment state because $\alpha^C > \alpha^T$ and/or because there is much more difference in mean $Y$ between the BPL card holders and others in the treatment state, then the modified estimator, $DD'$, picks that up as a large decline in the mean for the control states in the postperiod—a positive bias.

The strict condition for no bias requires that $\alpha^C = \alpha^T$ and that $E[(Y^C_{pre,N} - Y^C_{pre,B}|X] = E[(Y^T_{pre,N} - Y^T_{pre,B})|X]$. Thus, the sufficient conditions for an unbiased estimate are that in the presurvey (1) the share of households with BPL cards in Chhattisgarh is equal to the share in border districts, and (2) the average difference in protein consumption between households with BPL ration cards and households without ration cards in Chhattisgarh is equal to the difference in border districts. Although these are stringent conditions, we utilize border districts precisely because they are similar to Chhattisgarh.[21]

Given these conditions, we exclude border districts from states that are most different from Chhattisgarh. Specifically, we exclude border districts in Andhra Pradesh and Maharashtra because they differ the most from Chhattisgarh in terms of household expenditure in the presurvey, and we exclude border districts in Orissa and Uttar Pradesh because they differ the most in terms of protein consumption in the presurvey. Columns 6 and 7 of table 5 report these estimates where we restrict the sample in the postperiod to those that do and do not have BPL cards. These results continue to suggest that households with ration cards that entitle them to the highest PDS subsidies are driving the change in protein consumption in Chhattisgarh.

Last, we reestimate the specifications described above using total calorie consumption as the dependent variable in the bottom panel of table 5. The estimates suggest that total calorie consumption did increase for households most likely to be eligible for the largest PDS subsidies, and we see that when we restrict the households in the postperiod to only those entitled to large PDS

[21] In results not reported, we cannot reject the hypotheses that (1) the share of households with BPL cards in Chhattisgarh is equal to the share in border districts in the postsurvey and (2) the average difference in protein consumption between households with proxied ration cards and households without proxied ration cards in Chhattisgarh is equal to the difference in border districts in the presurvey.

subsidies, calorie consumption similarly increases in Chhattisgarh relative to border districts.

## VII. Robustness Checks of the Baseline Specification

We perform a number of additional robustness checks for our baseline specification. First, given the differential levels of treatment caused by the national reforms discussed in Section III, we reestimate the baseline specification in columns 1–3 of table 6 but respectively restrict the border districts to those from states where rations were larger than the provision by the central government (Andhra Pradesh and Orissa), to those from states where grains were not efficiently distributed and the increase in rations had very little effect on actual PDS consumption (Jharkhand and Uttar Pradesh), and to those where the national reforms resulted in larger PDS consumption, albeit by much less than in Chhattisgarh (Madhya Pradesh and Maharashtra).

The baseline pattern continues to hold for each of these different control groups. The difference is largest and most precisely estimated when comparing Chhattisgarh to Andhra Pradesh and Orissa (col. 1), where rations were already larger than the subsidy provided by the central government. However, consistent with the larger expansion of PDS subsidies in Chhattisgarh causing larger improvements in nutritional intake, households in Chhattisgarh had higher growth in protein consumption than border districts from Jharkhand and Uttar Pradesh (col. 2) and higher growth than border districts from Madhya Pradesh and Maharashtra (col. 3).[22]

Second, table 6 also estimates a slightly modified specification that allows treatment to vary on the basis of prereform coverage of FPSs. In particular, utilizing the 1999–2000 survey, we proxy for FPS coverage by calculating the average household PDS rice consumption among households that consume a positive amount of PDS rice for each district. We define treatment as the average percentage difference between the size of the BPL entitlement and average PDS consumption of those who consume PDS food grains as follows:

$$\text{Treatment}_d \begin{cases} 1 - \dfrac{(1/N_d)\Sigma_{i=1}^{N_d} \times \text{PDS\_Consumption}_{id,2,000} \times I_{id,2,000}}{\text{Total\_BPL\_Ration}_{2,000}} & \text{if district } d \text{ is in Chhattisgarh,} \\ 0 & \text{otherwise,} \end{cases}$$

where $i$ denotes households, $d$ denotes districts, $N_d$ denotes the total number of households consuming PDS grains in district $d$, and $I$ denotes an indicator

[22] In specifications not reported, the results are qualitatively identical when we use all of Madhya Pradesh (the state from which Chhattisgarh was separated) and all of India as the control group.

## TABLE 6

ROBUSTNESS CHECKS OF BASELINE SPECIFICATION

| | Dependent Variable: ln(Total Household Consumption of Protein over the Past 30 Days) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Variations of Baseline Specification | | | | | | | Placebo Specifications | |
| | Difference between Chhattisgarh and States Where Quotas Were above Central Government Subsidy (1) | Difference between Chhattisgarh and States Where Grains Were Inefficiently Distributed (2) | Difference between Chhattisgarh and States Where National Reforms Increased PDS Subsidies (3) | Treatment Allowed to Vary Based on Preexisting PDS Coverage (4) | Restrict Sample to Households Not Receiving Other Forms of Public Benefits (5) | Restrict Postsurvey to Households Surveyed in 2004 (6) | Restrict Postsurvey to Households Surveyed in 2005 (7) | Difference between Jharkhand and Border Districts (8) | Difference between Uttarakhand and Border Districts (9) |
| *CT* × *Post* | .236** | .099 | .113* | | .208*** | .227*** | .125 | .020 | −.021 |
| | (.091) | (.055) | (.062) | | (.058) | (.077) | (.075) | (.039) | (.047) |
| Treatment × *Post* | . . . | . . . | . . . | .476*** | . . . | . . . | . . . | . . . | . . . |
| | | | | (.157) | | | | | |
| *p*-value BS | . . . | . . . | . . . | . . . | .124 | .242 | .174 | . . . | . . . |
| *p*-value RI | . . . | . . . | . . . | . . . | .143 | .143 | .143 | . . . | . . . |
| Observations | 9,488 | 6,262 | 7,242 | 12,816 | 10,185 | 9,294 | 9,309 | 15,277 | 7,433 |

**Note.** Difference-in-differences estimate for total household consumption of protein over the past 30 days between 1999–2000 and 2004–5. Columns 1–3 reestimate the baseline specification but utilize different subsets of households for the comparison region. Column 1 utilizes households in border districts from Andhra Pradesh and Orissa, column 2 utilizes households in border districts from Jharkhand and Uttar Pradesh, and column 3 utilizes households in border districts from Madhya Pradesh and Maharashtra. Column 4 allows treatment to vary on the basis of the preexisting coverage of the Public Distribution System. Column 5 reestimates the baseline specification but restricts the sample to households that do not receive any other public benefit tracked by the National Sample Survey Organization. Columns 6 and 7 reestimate the baseline specification but restrict the sample in the postsurvey to households surveyed in 2004 and 2005, respectively. Columns 8 and 9 report placebo specifications that estimate the difference in consumption growth between the other newly formed states of Jharkhand and Uttarakhand and districts bordering each state. All specifications include district fixed effects and control variables. Control variables included are listed in footnote 17. All specifications also report *p*-values of the coefficient on the interaction of the Chhattisgarh indicator (*CT*) and a *Post* variable using the wild cluster bootstrap percentile-t method (*p*-value BS) and randomization inference (*p*-value RI) to estimate standard errors clustered by state. Standard errors clustered by district are reported in parentheses.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

function equal to 1 if the household consumes a positive amount of PDS rice.[23]

Using this proxy of prereform FPS coverage, we reestimate the baseline specification but replace the interaction of the *CT* and *Post* indicators with the interaction of Treatment and the *Post* indicator. In this specification, we would expect $\gamma > 0$ if regions with a worse prereform coverage of FPSs improved their nutrition by more. The estimate is presented in column 4 of table 6 and further suggests that nutrition improved the most in districts that had the largest growth in FPS coverage.[24] However, it is important to note that this proxy is not perfect and that low average PDS consumption among beneficiaries might be capturing higher leakage in addition to lack of access to FPSs.

Third, we provide evidence that our results are not driven by improvements to other forms of public assistance. A number of other types of public assistance use criteria for eligibility that are similar to the criteria used for the PDS. These include Food For Work, Annapurna, Integrated Child Development Services, and the Midday Meal Schemes, each of which supplies households with food items and might alter diet choice. In order to rule out the effect of changes to these programs, we restrict our sample to households that receive no other types of public support tracked by the NSSO consumer expenditure surveys. Column 5 of table 6 demonstrates that it is unlikely that our results are an artifact of improvements in other forms of public assistance. The estimate is nearly identical in magnitude to the baseline estimates in table 4 and is more precise.

Fourth, given the delayed implementation of the PDS (Control) Order of 2004, we would expect a larger change in nutrition for households surveyed in 2004 as opposed to those surveyed in 2005 if the change in nutrition was being caused by an increase in FPSs. We restrict the sample in the postround to households surveyed in 2004 and 2005 in columns 6 and 7, respectively. Consistent with the changes being caused by the increase in FPS coverage, the baseline patterns are much stronger in column 6 when we restrict the postround to only households surveyed in 2004. Additionally, when we restrict the postround to households surveyed in 2005 in column 7, the magnitude of the estimate is smaller and less precisely estimated.

[23] We chose not to utilize average PDS consumption in a district as a proxy of prereform FPS coverage because it would also capture differences in the share of the population that is below the poverty line.

[24] In specifications not shown, all results presented in tables 4–9 continue to hold when using this alternate specification as the baseline specification, and the estimates are more precisely estimated.

Fifth, we provide evidence that our results are not common to all newly formed states in India. It is possible that newer and smaller states have fewer entrenched interests and smaller oversight costs. The better overall governance in these states could improve public services such as the PDS and result in higher protein consumption. If these factors are decisive, then we should expect to observe similar patterns of growth in protein consumption in the newly formed states of Jharkhand and Uttarkhand. These states were formed at the same time as Chhattisgarh, were also separated from large and relatively poor states (Bihar and Uttarakhand, respectively), and are approximately the same size as Chhattisgarh.

Neither Jharkhand nor Uttarakhand, however, had higher growth in protein consumption than the districts bordering each state. Columns 8 and 9 of table 6 report the differences in growth for Jharkhand and Uttarakhand, respectively, using the baseline specification. The estimate is positive in column 8 and negative in column 9, the magnitude of each is lower than the baseline estimates in table 4, and neither is statistically significant at conventional levels.

Additionally, table 7 investigates matching methods to estimate the effects of the PDS reforms in Chhattisgarh on diet choice. One possibility is to utilize the difference-in-differences matching estimator proposed by Smith and Todd (2005) and Blundell and Costa-Dias (2000). This estimator is the difference between the matching estimator in Chhattisgarh and the matching estimator in border districts, which each uses a Post indicator to define treatment. The standard error is calculated with the bootstrap.

**TABLE 7**

**MATCHING ESTIMATES OF DIFFERENCES IN PROTEIN CONSUMPTION BETWEEN 1999–2000 AND 2004–5**

| | Dependent Variable: ln(Protein Consumption) | |
|---|---|---|
| | Chhattisgarh (1) | Border Districts (2) |
| *Post* | .050** | −.101*** |
| | (.023) | (.018) |
| 95% confidence interval | .005, .096 | −.137, −.065 |
| Observations | 5,088 | 7,728 |

**Note.** Difference in nongrain consumption between 1999–2000 and 2004–5 for Chhattisgarh and border districts separately using the matching estimator proposed by Abadie et al. (2004). Estimates use the bias-corrected and robust options and utilize four matches. Treatment is defined as the *Post* variable, and control variables used in the baseline empirical specification are the matching variables listed in footnote 17. Most importantly, the estimated 95% confidence intervals of the two estimates do not overlap.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

However, Abadie and Imbens (2008) demonstrate that standard errors calculated with the bootstrap fail to perform well in even the most simple matching estimator, which suggests that such an estimator might be inappropriate. We instead use the matching estimator proposed by Abadie et al. (2004) to estimate treatment separately in Chhattisgarh and border districts, using the Post indicator to define treatment and matching on the household-level control variables in the baseline specification. The change in nutrition in Chhattisgarh is presented in column 1 of table 7, and the change in border districts is presented in column 2. The difference between the two point estimates suggests that the increase in PDS subsidies in Chhattisgarh improved protein consumption by approximately 15.1% (the difference between 0.050 and −0.101). Although we cannot reliably estimate the standard error of that difference, the two 95% confidence intervals of the two estimates do not overlap, which suggests that, similar to the baseline estimates, protein consumption increased by more in Chhattisgarh than in border districts.

Additionally, in table 8, we estimate how overall expenditure changed in response to the increase in food price subsidies. Column 1 estimates the baseline specification utilizing the natural logarithm of total expenditure as the dependent variable, column 2 utilizes the natural logarithm of nonfood expenditure as the dependent variable, and column 3 utilizes the natural logarithm of food expenditure as the dependent variable. We find little evidence that expenditures changed differently in Chhattisgarh relative to border districts in any specifications.

**TABLE 8**
**DIFFERENCES IN GROWTH OF EXPENDITURE BETWEEN CHHATTISGARH AND BORDER DISTRICTS**

| | Dependent Variable | | |
|---|---|---|---|
| | ln(Total Monthly Per Capita Expenditure) (1) | ln(Total Monthly Per Capita Nonfood Expenditure) (2) | ln(Total Monthly Per Capita Food Expenditure) (3) |
| *CT* × *Post* | .021 | .023 | .009 |
| | (.073) | (.074) | (.068) |
| *p*-value BS | .557 | .546 | .837 |
| *p*-value RI | .571 | .429 | .571 |
| Observations | 12,816 | 12,816 | 12,816 |

**Note.** Difference-in-differences estimate for household expenditure between 1999–2000 and 2004–5. All specifications include district fixed effects and control variables. Control variables included are listed in footnote 17. All specifications also report *p*-values of the coefficient on the interaction of the Chhattisgarh indicator (*CT*) and a *Post* variable using the wild cluster bootstrap percentile-t method (*p*-value BS) and randomization inference (*p*-value RI) to estimate standard errors clustered by state. Standard errors clustered by district are reported in parentheses.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

However, it is important to note that the NSSO counts total rupees spent on consumption. So if a household consumed the same diet before and after an increase in PDS subsidies, the household would actually spend less on food. The fact that households did not decrease their food expenditures by more than neighboring districts suggests that households spent at least some of the subsidy on more expensive, nutritious foods. This is corroborated by the increase in nutrition that is the main finding of the article.[25]

Finally, we provide evidence that the trends in protein consumption in districts that would become Chhattisgarh and border districts were similar before the PDS reforms in Chhattisgarh. Table 9 demonstrates that growth in protein consumption only increased in Chhattisgarh relative to border districts after the PDS reforms were implemented. Columns 1 and 2 estimate the baseline specification for the growth of protein consumption between 1993 (50th round) and 1997 (53rd round), columns 3 and 4 do so between 1997 and 1998 (54th round), and columns 5 and 6 do so between 1998 and 1999–2000 (55th round). The coefficients in columns 1–6 are all lower in magnitude than the estimates presented in tables 4–8, and none are statistically significant at conventional levels.

Column 7 of table 9 combines all surveys conducted before the PDS reforms (50th, 53rd, and 54th rounds) with the two surveys used in the baseline analysis (55th and 61st thick rounds) and estimates the difference in protein consumption growth between Chhattisgarh and border districts for each period. The estimate for the period corresponding to Chhattisgarh's PDS reforms (0.193) is similar to the baseline estimate, and there is still little difference in the growth of protein consumption between Chhattisgarh and border districts in periods before the PDS reforms. Additionally, despite the lack of precision of the estimates of the changes in protein consumption before the reforms in Chhattisgarh, we can reject the hypothesis of all interaction terms being equal at the 10% level ($p = .070$).

## VIII. Conclusion

This article analyzes changes in diet choice in Chhattisgarh relative to border districts following PDS reforms that dramatically increased the availability of PDS food grains in the state. We find that relative to border districts, households in Chhattisgarh improved their nutritional intake. These results appear

[25] We cannot rule out the possibility of households increasing savings as well. After obtaining data on total bank deposits by district obtained from the Reserve Bank of India, we see that bank deposits grew by much more in Chhattisgarh than in border districts. Specifically, total deposits grew by 174% in Chhattisgarh as opposed to 96% in border districts.

## TABLE 9

TRENDS IN NONGRAIN CONSUMPTION BEFORE FORMATION OF CHHATTISGARH

| | Dependent Variable: ln(Total Household Consumption of Protein over the Past 30 Days) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Difference between 1993 and 1997 | | Difference between 1997 and 1998 | | Difference between 1998 and 1999 | | Full Sample |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $CT \times Post_{t-3}$ | .107 | .051 | . . . | . . . | . . . | . . . | .037 |
| | (.115) | (.094) | | | | | (.093) |
| $CT \times Post_{t-2}$ | . . . | . . . | −.107 | −.060 | . . . | . . . | −.040 |
| | | | (.096) | (.100) | | | (.104) |
| $CT \times Post_{t-1}$ | . . . | . . . | . . . | . . . | .063 | .061 | .011 |
| | | | | | (.076) | (.073) | (.051) |
| $CT \times Post_{t}$ | . . . | . . . | . . . | . . . | . . . | . . . | .193** |
| | | | | | | | (.079) |
| District fixed effects and control variables | No | Yes | No | Yes | No | Yes | Yes |
| *p*-value of test of all higher-order terms being equal | . . . | . . . | . . . | . . . | . . . | . . . | .070* |
| *P*-value BS | .458 | .625 | .448 | .697 | .591 | .521 | .166 |
| *p*-value RI | .286 | .571 | .714 | .714 | .286 | .286 | .143 |
| Observations | 11,275 | 11,275 | 4,077 | 4,077 | 7,201 | 7,201 | 25,505 |

**Note.** Difference-in-differences estimate for nongrain consumption in periods before the Public Distribution System reforms in Chhattisgarh. Columns 1 and 2 present estimates of the difference-in-differences between 1993 (50th round) and 1997 (53rd round), columns 3 and 4 present estimates of the difference-in-differences between 1997 (53rd round) and 1998 (54th round), columns 5 and 6 present estimates of the difference-in-differences between 1998 (54th round) and 1999 (55th round), and column 7 pools all surveys and estimates changes in consumption in Chhattisgarh relative to border districts at different time periods. In column 7, the base period is the 50th round of the National Sample Survey Organization consumer expenditure survey. Control variables included are listed in footnote 17. In specifications not including district fixed effects, control variables also include an indicator equaling 1 if the household resided in Chhattisgarh. All specifications also report *p*-values of the coefficient on the interaction of the Chhattisgarh indicator (*CT*) and a *Post* variable using the wild cluster bootstrap percentile-t method (*p*-value BS) and randomization inference (*p*-value RI) to estimate standard errors clustered by state; in column 7 the *p*-value is for a test of the baseline estimate equaling 0 (as opposed to preexisting trends). Standard errors clustered by district are reported in parentheses.

* Significance at the 10% level.

** Significance at the 5% level.

to be driven by households in Chhattisgarh that were most likely to be entitled to the largest food subsidies through PDS ration cards. We do not find evidence that households in Chhattisgarh that were the least likely to be entitled to PDS subsidies changed their diet relative to households in border districts. We also find that these changes in nutrient consumption are not a consequence of improvements to other forms of public assistance that target nutrition.

These results have implications for the recent improvement in PDS delivery in a number of Indian states (Khera 2011*b*). Our findings suggest that this improvement could have been accompanied by an improvement in protein consumption. Our results also suggest that the proposed expansion of the PDS under the NFSA could help to reduce persistent malnourishment and food insecurity in the country.

The analysis still leaves a number of questions unanswered. We do not know whether other forms of aid might be more effective at improving nutrition than a large grains subsidy. Other forms of aid include subsidies for more nutritious foods, food stamps, and even cash subsidies. Although our results demonstrate that subsidizing staple grains can lead to other nutritional improvements, it is possible that direct subsidies for other types of foods may have a larger effect on nutritional outcomes. Chhattisgarh, in its most recent PDS reform in 2012, created a statewide subsidy for pulses after implementing a successful pilot program.

This article does not consider the potential adverse effects of PDS procurement of food grains on agricultural markets. Many commentators suggest that the government-mandated MSP does more to provide income support to farmers than to stabilize food prices (Rakshit 2003). Some studies suggest that these interventions in agricultural markets depress investment in the agricultural sector (Parikh, Ganesh-Kumar, and Darbha 2003). The effects of government procurement on agricultural markets are likely to be magnified as a result of increased procurement under the NFSA. A number of policy makers are therefore concerned about the NFSAs implications for agricultural markets (Gulati, Gujral, and Nandakumar 2012).

Last, we do not have a definitive explanation for why the effects of food assistance on nutrition in this setting differ from other settings. It is possible that the differences between our results and those of Tarozzi (2005) are driven by differences in stages of development of the treated populations. Households in Chhattisgarh are likely to be poorer than those in Andhra Pradesh. More research is needed to arrive at a deeper understanding of the generalizability of these results.

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